Worksheet - Real-life graphs

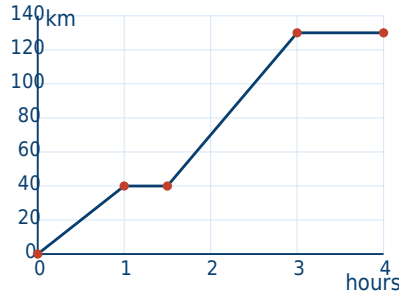
Year: Year 9 · 20

Show your working.

Question 1

Question 1 – Reading a distance-time graph *(Section A · Skills practice)*

The graph shows a coach journey. Time is in hours since the coach left and distance is in kilometres from the start.



a. Find the speed of the coach in the first hour.
b. For how long did the coach stop? Explain how you can tell from the graph.
c. Find the speed between 1.5 and 3 hours.
d. Find the average speed for the first 3 hours, to 1 decimal place.

Question 2

Question 2 – A conversion graph *(Section A · Skills practice)*

A conversion graph between miles and kilometres is a straight line through the origin. It passes through $(5, 8)$, meaning 5 miles $=$ 8 km.

a. Find the gradient of the line and say what it means.
b. Convert 30 miles to kilometres.
c. Convert 100 kilometres to miles.
d. Use the formula $F = 1.8C + 32$ to convert 25°C to degrees Fahrenheit.

Question 3

Question 3 – What the numbers mean *(Section A · Skills practice)*

A plumber charges a call-out fee plus an hourly rate, so the cost is $C = 30h + 40$ pounds for h hours of work.

a. What does the number 30 mean? What does the number 40 mean?
b. Find the cost of a job lasting 2.5 hours.
c. Find the number of hours for a bill of £175.

d. Where does the graph of C against h cross the vertical axis?

Question 4

Question 4 – Speed from gradients *(Section A · Skills practice)*

The table shows three parts of a cycle ride, each at a steady speed.

Part	Time (hours)	Distance (km)
1	0 to 1	0 to 15
2	1 to 3	15 to 55
3	3 to 4	55 to 55

a. Find the speed in part 1.
b. Find the speed in part 2.
c. What does part 3 show?
d. In which part was the cyclist fastest and how can you see it from a graph?

Question 5

Question 5 – Exponential growth *(Section A · Skills practice)*

Some quantities grow by multiplying by the same factor each time. A culture of bacteria doubles every hour, starting with 50 bacteria.

Hours t	0	1	2	3	4	5
Number	50	?	?	?	?	?

a. Complete the table.
b. Write a formula for the number N after t hours.
c. Find the number after 10 hours.
d. Explain how the graph differs from a straight line.

Question 6

Question 6 – Reciprocal graphs *(Section A · Skills practice)*

The relation $y = \dfrac{12}{x}$ is a reciprocal graph. Complete the table and answer the questions.

x	1	2	3	4	6	12
y	?	?	?	?	?	?

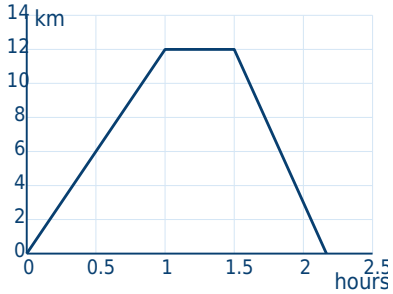
a. Complete the table.
b. Find y when $x = 0.5$.
c. Find x when $y = 0.5$.

d. Why can x never be 0?

Question 7

Question 7 – Mia's bike ride *(Section B · Real-life practice)*

Mia leaves home at 10:00 and cycles 12 km to a café in 1 hour. She rests for 30 minutes, then rides home along the same road in 40 minutes.



a. Find her speed on the way out.
b. At what time does she leave the café?
c. Find her speed on the way back.
d. Find the total distance she travels and her average speed over the whole trip, to 1 decimal place.

Question 8

Question 8 – The data plan *(Section B · Real-life practice)*

A mobile phone plan costs £10 per month for the first 5 GB of data. After that each extra GB costs £2. The monthly cost is a piece-wise linear graph.

Data (GB)	0	5	8	12
Cost (£)	10	10	16	?

a. Find the cost for 12 GB.
b. Write the cost for $x \leq 5$ and for $x > 5$.
c. Find the amount of data for a bill of £24.
d. A competitor charges £1.50 per GB with no fixed fee. Which plan is cheaper for 12 GB?

Question 9

Question 9 – Car park charges *(Section B · Real-life practice)*

A car park charges: up to 1 hour £1.50; up to 2 hours £2.50; up to 4 hours £4.00; then £1.00 for each extra hour or part of an hour, to a maximum of £9.00 per day.

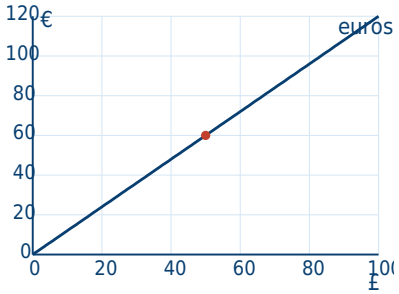
a. Find the charge for 45 minutes.
b. Find the charge for 3 hours 15 minutes.

c. Find the charge for 7 hours.
d. How many hours of parking cost the maximum £9.00? Explain.

Question 10

Question 10 – Changing money *(Section B · Real-life practice)*

Before a holiday in Spain, Zainab uses the conversion graph £1 =*€1.20*. The line passes through the origin.



a. Read from the graph how many euros she gets for £50.
b. Find the number of pounds that give €90.
c. Write a formula for euros E in terms of pounds P.
d. On return she has €36 left. How many pounds is that?

Question 11

Question 11 – Filling and emptying the tank *(Section B · Real-life practice)*

A water tank on a farm holds 40 litres at the start. It is filled at 15 litres per minute for 20 minutes. Then the tap is opened and it drains at 25 litres per minute.

a. Find the volume of water after 20 minutes.
b. Write the volume V after t minutes of filling.
c. How long does the tank take to empty after the tap is opened?
d. How long altogether from the start until the tank is empty?

Question 12

Question 12 – The growing culture *(Section B · Real-life practice)*

A scientist starts with 200 bacteria in a dish. The number doubles every hour.

Hour	0	1	2	3	4	5	6
Number	200	400	800	?	?	?	?

a. Complete the table.
b. Write a formula for the number after t hours.
c. After how many whole hours does the number first exceed 10 000?
d. Why must the real growth slow down eventually?

Question 13

Question 13 – Travel time and speed *(Section B · Real-life practice)*

A train company says that the time t hours for a journey of 240 km depends on the average speed s km/h, with $t = \dfrac{240}{s}$.

Speed s	40	48	60	80	120
Time t	?	?	?	?	?

a. Complete the table.
b. Describe the shape of the graph of t against s.
c. Find the speed needed for a journey time of 2.5 hours.
d. A train travels at 90 km/h. Find the time in hours and minutes.

Question 14

Question 14 – Sharing the minibus *(Section B · Real-life practice)*

A school hires a minibus for £120. Each pupil pays an equal share, so the cost per pupil is $y = \dfrac{120}{n}$ pounds for n pupils.

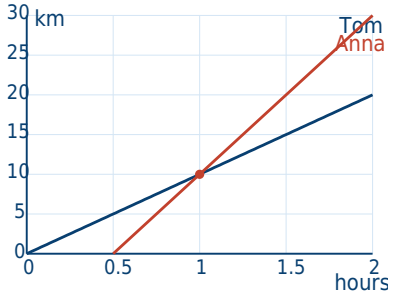
Pupils n	2	3	4	5	6	8
Cost £y	?	?	?	?	?	?

a. Complete the table.
b. What happens to the cost per pupil as the number of pupils increases?
c. How many pupils are needed to bring the cost to £10 each?
d. Each pupil also pays £2.50 for a snack. Write the total cost per pupil for 8 pupils.

Question 15

Question 15 – Two cyclists *(Section C · Problem solving)*

Tom sets off on a bike ride at 10:00 at a steady speed of 10 km/h. Anna sets off from the same place 30 minutes later at 20 km/h and follows the same route.



a. Write an equation for the distance d km that Tom has travelled after t hours.
b. Write an equation for Anna's distance, for $t \geq 0.5$.

c. Use the graph to find when and where Anna catches Tom.
d. Check your answer by solving the equations.
e. How long does Tom have to wait if the finish is 25 km away and Anna arrives first?

Question 16

Question 16 – The currency bureau *(Section C · Problem solving)*

A bureau gives €1.20 for each £1 after taking a £3 fee. The bank gives €1.18 for each £1 and takes no fee.

Pounds changed	10	50	100	180
Bureau (€)	8.40	56.40	116.40	212.40
Bank (€)	11.80	59.00	118.00	212.40

a. Show how the bureau value for £50 was found.
b. Write a formula for each: bureau $E = ?$ and bank $E = ?$.
c. Show that the two give the same amount for £180.
d. Which is better for £500? Which is better for £60?

Question 17

Question 17 – The electricity bill *(Section C · Problem solving)*

An energy company charges a standing charge of £8 per month plus 20p per unit for the first 100 units, and 15p per unit after that.

Units	0	50	100	200	300
Bill (£)	8	18	28	43	?

a. Show how the bill for 200 units was found.
b. Find the bill for 300 units.
c. Find the bill for 250 units.
d. Explain why the graph has a bend at 100 units.
e. A customer pays £58. How many units did she use?

Question 18

Question 18 – A car loses value *(Section C · Problem solving)*

A new car costs £15 000. It loses 20% of its value each year, so its value after t years is $V = 15000 \times 0.8^t$.

Years t	0	1	2	3	4	5
Value £	15 000	12 000	9 600	7 680	?	?

a. Complete the table.
b. Find the loss in value in the first year and in the third year.
c. When does the value first fall below £5 000?
d. Is the graph a straight line? Explain.

Question 19

Question 19 – Filling the pool *(Section C · Problem solving)*

A swimming pool is filled by n identical hoses. Using one hose takes 24 hours. The time is $t = \dfrac{24}{n}$ hours.

Hoses n	**1**	**2**	**3**	**4**	**5**	**6**	**8**
Time t (h)	24	12	8	6	?	4	3

a. Find the missing time for 5 hoses.
b. How many hoses are needed to fill the pool in 2 hours?
c. The council has 3 hoses and wants to fill the pool in under 6 hours. Is that possible?
d. Explain why doubling the number of hoses halves the time.

Question 20

Question 20 – Challenge: linear against exponential *(Section D · Challenge)*

Sara saves £100 and then £10 each week: $y = 100 + 10x$. Her friend Jo starts with £1 and doubles her savings every week: $y = 2^x$.

Week x	**0**	**2**	**4**	**6**	**8**	**10**
Sara $100 + 10x$	100	120	140	160	180	200
Jo 2^x	1	4	16	64	?	?

a. Complete the table.
b. In which week does Jo first have more than Sara? Check weeks 7 and 8.
c. What does this tell you about linear and exponential growth?
d. Use the pattern to find how much Jo would have in week 20 and week 30.
e. Explain why Jo cannot really keep doubling for 30 weeks.